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November 10, 1991

DTIC
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DEC 1 7 1991
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Defense Technical Information Center
Building 5
Cameron Station
Alexandria, VA 22314

Dear DTIC,

Enclosed is the Final Technical Report for the project entittled "Wave Groups in Shallow Water," N00014-90-J-1021.
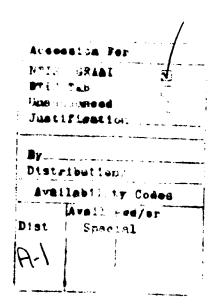
Sincerely,

Steve Elgar

Steve Elgar

91-18039

Final Technical Report for the Project:
Wave Groups in Shallow Water, N00014-90-J-1021

The immediate scientific objective of this project was to understand and predict wave groups throughout the shoaling region seawards of the zone of wave breaking.

During FY90-91 wave group prediction models based on linear theory were developed and/or implemented. In addition, observations of sea surface elevation were made in 19 m water depth near the North Carolina coast during the SAMSON and Delilah field experiments (Aug. 1990 - May 1991). Wave group statistics from these data, as well as from data previously obtained, have been compared to model predictions. The comparisons indicate that, for a wide range of ocean conditions, seaward of the shoaling region wave group statistics are not inconsistent with linear theory.

Linear theory does not accurately predict observations of group statistics in shallow depths (eg, less than 10 m) where nonlinear interactions become important to the evolution of the wave field. During FY91 a technique to numerically simulate a wave field with a specified power spectrum and bispectrum was developed, thus allowing wave fields with quadratic nonlinearities to be simulated. Comparisons between observed and simulated group statistics are being made.

One of the primary results of this study is that wave group statistics observed in the ocean at 3 depths (all greater than 10 m) for a very large range of wave conditions are not inconsistent with linear theory. Wave group prediction models that do not include the effect of correlations between waves separated by several intervening waves underpredict the number of sequential large waves. On the other hand, a model that includes correlations of waves separated by as many as six intervening waves accurately predicts the observed wave group statistics. Another result is that although computationally convenient, wave group prediction models based on power spectral shape alone are not as accurate as models based on direct simulations of the wave field.

ONR-Sponsored Publications

P = published
IP = in press
PS = paper submitted
IC = invited conference paper
C = contributed conference paper
R = technical report

P- Elgar, Steve, M.H. Freilich, and R.T. Guza, 1990 Model-data comparisons of moments of nonbreaking shoaling surface gravity waves, JGR 95, 16055-16063.

P- Freilich, M.H., R.T. Guza, and Steve Elgar, 1990 Observations of nonlinear effects in directional spectra of shoaling surface gravity waves, JGR 95, 9645-9656.

P- Elgar, Steve, C.W. Van Atta, and M. Gharib, 1990 Cross- bispectral analysis of the coupling between a vibrating cylinder and its wake in low Reynolds number flow, J. Fluids and Structures 4, 59-71.

P- Pezeshki, C., Steve Elgar, and R.C. Krishna, 1990 Bispectral analysis of systems possessing chaotic motion, J. Sound and Vibration 137, 357-368.

P- Mitchell, K., L. James, Steve Elgar, and M. Pitts, 1990 Water level fluctuations in irrigation canals, ASCE J. Irrigation and Drainage 116, 261-272.

P- Chandran, V. and Steve Elgar, 1990 Bispectral analysis of 2-D random processess, IEEE ASSP 38,2181-2186.

P- Pezeshki, C., Steve Elgar, and R.C. Krishna, 1991 An examination of the multi-frequency excitation of the buckled beam, J. Sound and Vibration 148, 1-9.

IP- Pezeshki, C., W.H. Miles, and Steve Elgar, 1991 Signal processing for nonlinear structural dynamical systems, ASME Applied Mechanics Reviews, to appear November 1991.

IP- Pezeshki, C., Steve Elgar, R. C. Krishna, and T.D. Burton, Auto- and cross-bispectral analysis of a system of two coupled oscillators with quadratic nonlinearities possessing chaotic motion, J. Applied Mechanics, in press.

IP- Chandran, V. and Steve Elgar, 1991 Mean and variance of the bispectrum for harmonic random processess: an analysis including leakage effects, IEEE ASSP, to appear December, 1991.

IP- Hagelberg, Teresa, N. Psias, and Steve Elgar, Linear and nonlinear coupling between orbital forcing and the marine 18-O record during the late Neogene, Paleoceanography, in press.

IP- Elgar, Steve, R. Guza, M. Freilich, and M. Briggs, Laboratory simulations of directionally spread shoaling waves, ASCE J. Waterway, Port, Coastal, and Ocean Engineering, to appear Jan. 1992.

IP- Miles, W.H., C. Pezeshki, and Steve Elgar, Bispectral analysis of a fluid elastic system: the cantilevered pipe, J. Fluids and Structures, in press.

PS- Elgar, Steve, Teresa Hagelberg, and J. Kadtke, Paleoclimatic attractors, new data, futher analysis, Nature, sub judice.

IC- Elgar, Steve 1991 Bispectral Analysis of Systems Possessing Chaotic Motion, ONR Symposium on Nonlinear Surface Waves, Baltimore, May 1991.

C- Elgar, Steve, M. Freilich, and R. Guza 1990 Model predictions of nonbreaking shoaling waes, Proc. 22nd Coastal Engineering Conference, ASCE, Delft, July 1990.

C- Chandran, V. and Steve Elgar, 1991, Shape discrimination using invariants defined from higher-order spectra, Proc. of the IEEE Int'l Conf. on ASSP (ICASSP'91), 5, 3102-3109.

R- Holman, R, Bowen, Dalrymple, Dean, Elgar, Flick, Freilich, Guza. Hanes, Kirby, Madsen, Sternberg, and Svendsen, Report for the Nearshore Processes Workshop, St. Petersburg, FL, Report OSU-CO-90-6, Oregon State University, 42pp

Statistics

7 Papers published, refereed journals
7 Papers submitted, refereed journals
0 Books or chapters published, refereed publication
0 Books or chapters submitted, refereed publication
1 Invited presentations
2 Contributed presentations
1 Technical reports and papers, non-refereed journals
0 Undergraduate students supported
2 Graduate students supported
0 Post-docs supported
0 Other professional personnel supported

EEO/Minority Support

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